

## SECTION 01810

### GENERAL COMMISSIONING PROCESSES

#### PART 1 - GENERAL

##### 1.1 REFERENCES

##### 1.2 SUMMARY

- 1.2.1 This Section includes general administrative and procedural requirements for the Commissioning Process to supplement other Division 1 commissioning process activity Sections and other Sections in Divisions 2 through 16 that specify testing of components, systems and assemblies.

##### 1.3 RELATED REQUIREMENTS

- 1.3.1 Design Intent documentation, provided by Owner.
- 1.3.2 Basis of Design Documentation prepared by D/B Contractor.
- 1.3.3 The provisions of Section 01330, "Submittal Procedures" apply to this Section.
- 1.3.4 The provisions of Section 01781, "Operation and Maintenance Data" apply to this Section
- 1.3.5 The provisions of Section 01815, "HVAC Commissioning Processes" apply to this Section.

##### 1.4 DEFINITIONS

Basis of Design: Information necessary to accomplish the design intent, including weather data, interior environmental criteria, design assumptions, cost goals, and references to applicable codes, standards, regulations, and guidelines.

Basis of Design: A document that records the concepts, calculations, decisions, and product selections used to meet the Owner's Project Requirements (Owner's Program and Design Intent) and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.



Commissioning Authority: The designated person, company, or entity who implements the overall commissioning process.



Commissioning Authority: An entity identified by the Owner who plans, schedules, and coordinates the commissioning team to implement the Commissioning Process.

Commissioning Plan: A document defining the commissioning process, which is developed in increasing detail as the project progresses through its various phases.

Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the Commissioning Process.

Commissioning Team: Those people responsible for working together in carrying out the commissioning process.

Commissioning Team: The individuals who through coordinated actions are responsible for implementing the Commissioning Process.

Commissioning Team: A group of individuals, each having authority to on behalf of the entity he or she represents, explicitly organized to implement the Commissioning Process through coordinated actions.

D/B Contractor: Design/Build Contractor who is the prime contractor the Government.

Design Intent: A detailed explanation of the ideas, concepts, and criteria that are defined by the Owner to be important. This typically is an expansion of the information provided in the Owner's Program.

Owner's Program: The document that outlines the Owner's overall vision for the facility and expectations of how it will be used and operated.

Owner's Project Requirements: A written document that details the functional requirements of a project and the expectations of how it be used and operated. This includes project and design goals, measurable performance criteria, budgets, schedules, success criteria, and supporting information.

## 1.5 COMMISSIONING TEAM

1.5.1 The Commissioning Team shall consist of, but not be limited to, representatives of the following entities:

- a) The Commissioning Authority.
- b) The Owner, including representatives of the NAVFACENGCOM EFA or EFD Staff, major claimant (including operations and maintenance staff), and facility user (including operations and maintenance staff).
- c) D/B Contractor, including the architectural design professionals, HVAC design professionals, and electrical design professionals; [construction manager] <Insert another

**term for person in charge of construction operations>;** and Contractor's Quality Control manager.

- d) First-tier subcontractors, including Mechanical; Electrical; Automatic Temperature Control; Testing, Adjusting, and Balancing subcontractors; and other subcontractors, installers, equipment suppliers, and specialists deemed appropriate by the Commissioning Authority.

#### 1.6 OWNER'S RESPONSIBILITIES

The Owner will provide or perform the following:

- a) Provide Owner's Program and Design Intent Documentation.
- b) Assign operator and maintenance personnel and schedule them to participate in Commissioning Team activities, including but not limited to the following:
  - (1) Design and construction phase coordination meetings specified in this Section and in Section 01815, "HVAC Commissioning Processes."
  - (2) Initial Owner training session at initial placement of major equipment.
  - (3) Maintenance orientation and inspection.
  - (4) Piping and ductwork test and flushing verification meetings.
  - (5) Procedures meeting for testing, adjusting and balancing.
  - (6) Owners training session.
  - (7) Verification demonstrations.
  - (8) Final review at acceptance meeting.
- c) Provide qualified personnel for video taping and editing of training sessions.
- d) Video tape construction progress, including hidden shafts.
- e) Provide utility services required for the commissioning process.

#### 1.7 D/B CONTRACTOR'S RESPONSIBILITIES

- 1.7.1 The Architectural and Mechanical Design Professionals shall prepare the Basis of Design Documentation and submit it to the Owner and Commissioning Authority for approval. See "Mechanical Design Professional's Responsibilities in this Specification."

- 1.7.2 Provide utility services required for the commissioning process.

#### 1.7.3 Mechanical Design Professional's Responsibilities:

- a) Design and specify adequate maintenance accessibility for equipment.
- b) Attend the training sessions for Owner's operations and maintenance personnel. Conduct the training session pertaining to the overview of the system design, the system design goals and the rationale for equipment selection and system design.
- c) Attend initial meeting with Testing, Adjusting, and Balancing Contractor as scheduled by Commissioning Authority.
- d) Review test procedures submitted by the Commissioning Authority.
- e) Review testing, adjusting, and balancing report, checklists, and verification data sheets for system conformance to contract documents. Issue a report noting deficiencies requiring correction to the Commissioning Authority.
- f) Review test reports for compliance with Basis of Design documentation.
- g) Review Records (as-built) Documents for inclusion in final project documentation.
- h) Review and approve final commissioning report.

#### 1.7.4 D/B Contractor's Quality Control Staff Responsibilities:


- a) Include commissioning requirements in subcontractor agreements to ensure full cooperation in the commissioning process.
- b) Provide adequate accessibility to installed equipment for maintenance and component replacement or repair.
- c) Assign D/B Contractor representatives with expertise and authority to act on behalf of the D/B Contractor and schedule them to participate in Commissioning Team activities, including but not limited to the following:
  - (9) Design and construction phase coordination meetings specified in this Section and in Section 01815, "HVAC Commissioning Processes."
  - (10) Initial Owner training session at initial placement of major equipment.
  - (11) Maintenance orientation and inspection.
  - (12) Procedures meeting for testing, adjusting and balancing.
  - (13) Owners training session.

(14) Verification demonstrations.

(15) Final review at acceptance meeting.


- d) Certifies Work is complete and systems operational according to the Contract Documents, including calibration of instrumentation and controls.
- e) Certify that TAB work is complete, and submit the final TAB reports to the HVAC design professional for approval.
- f) Evaluate performance deficiencies identified in the test reports and, in collaboration with entity responsible for equipment and system installation, recommend corrective action.
- g) Review and approve final commissioning documentation.

#### 1.7.5 Commissioning Authority Responsibilities:

- a) Organize and lead the Commissioning Team.
- b) Prepare a design phase Commissioning Plan during design phase, to detail the extent and activities of the commissioning process including commissioning team organization; schedule; training; documentation requirements; and testing, verification, and quality control procedures.
-  c) During design phase, review and comment Bidding and Contract Documents with respect to their completeness in areas relating to the commissioning process. Verify that the design phase Commissioning Plan has been followed and that there are adequate devices included in the design to properly test, balance, and adjust systems and to document the performance of equipment and systems. Verify that interfaces between systems are recognized and coordinated.
- d) Prepare a construction-phase Commissioning Plan. Collaborate with the Mechanical, TAB, and Automatic Temperature Controls Contractors to develop test and inspection procedures. Include design changes and scheduled commissioning activities coordinated with overall Project Schedule. Identify responsibilities, by name, firm, and trade specialty, for performance of each commissioning task. Provide a copy of the construction phase Commissioning plan to the D/B Contractor.
- e) Review, and take appropriate action, submittals from all subcontractors and suppliers. Verify that the construction phase Commissioning Plan has been followed and that there are adequate devices included in the design to properly test, balance, and adjust systems and to document the performance of equipment and systems. Verify that interfaces between systems are recognized and coordinated.
- f) Convene Commissioning Team meetings for the purpose of coordination, communication, conflict resolution, and discuss

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progress status of commissioning processes. Responsibilities include arranging for facilities, preparing agendas and attendance lists, and notifying participants. The Commissioning Authority shall chair these events and prepare and distribute minutes to commissioning team members and attendees within five workdays of the commissioning event.

- g) Convene an initial construction-phase coordination meeting within 90 days of the award of the Contract for the purpose of reviewing the complete commissioning process and establishing tentative schedules for operations and maintenance submittals; training sessions; testing; testing, adjusting, and balancing work; and job completion.
- h) Observe and inspect construction and reporting progress and deficiencies. In addition to compliance with Contract Documents and Design Intent, inspect equipment and systems installation for adequate accessibility for maintenance and component replacement or repair.
- i) Create project-specific test and inspection procedures and checklists.
- j) Schedule, witness, and document tests, inspections, systems startup, demonstrations, and training events described in the Contract Documents. Include a summary of deficiencies in the Issues Log. See "Issues Log" requirements in Part 1 Article "Commissioning Documentation."
- k) Compile test data and inspection reports and certificates and include them in the Systems Manual and Commissioning Plan.
- l) Certify the date of acceptance for each item of equipment to the D/B Contractor and Owner for start of the warranty period.
- m) Immediately before systems orientation and inspection convene an initial Owner training session. The Owner's operations and maintenance personnel, design professionals, and Contractors shall attend this session. The HVAC design professional shall present HVAC system Design Intent, Basis of Design, and installed systems.
- n) Review Project Record Documents for accuracy with respect to the installed systems. Request revisions from the D/B Contractor to achieve accuracy.
- o)  Review and approve the operations and maintenance manuals for correct data and that they follow the specified outline and format.
- p) Convene the Commissioning Team for operations and maintenance training sessions. Prepare an agenda that follows the outline in the Systems Manuals, which shall be included as training material for participants.
- q) Prepare the Systems Manual.



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r) Prepare the final Commissioning Report.

s) Assemble the final documentation, including the Commissioning Report, the Systems Manual, and Project Record Documents, and submit to the Design/Build Contractor and Owner with recommendations for acceptance for review and acceptance.

1.7.6 Other First-Tier Subcontractor's Responsibilities: First-tier subcontractors are identified in Section 01310, "Administrative Requirements." Specific responsibilities for HVAC commissioning process activities are specified in Section 01815, "HVAC Commissioning Processes." General responsibilities include the following:

a) Assign representatives with expertise and authority to act on behalf of the first-tier subcontractor and schedule them to participate in Commissioning Team activities, including but not limited to the following:

- (1) Design and construction phase coordination meetings specified in this Section and in Section 01815, "HVAC Commissioning Processes."
- (2) Initial Owner training session at initial placement of major equipment.
- (3) Maintenance orientation and inspection.
- (4) Procedures meeting for testing, adjusting and balancing.
- (5) Owners training session.
- (6) Verification demonstrations.
- (7) Final review at acceptance meeting.

b) Prepare preliminary schedule for system orientation and inspections, operation and maintenance manual submission, training sessions, and equipment startup, for use by the Commissioning Authority. Update schedule on a weekly basis throughout the construction period.

c) Submit copies of submittals, operations and maintenance data, and as-built documents to the Commissioning Authority. Identify departures from Contract Documents so they may be processed as a deviation submittal.

d) Require cooperation of subcontractors for Commissioning Team activities.

e) Provide information to the Commissioning Authority for development of construction phase Commissioning Plan.

f) Coordinate the system orientation and inspection following the initial training session.

- g) Attend initial training session for Owner's operation and maintenance personnel and conduct system orientation and inspection.
- h) Update Project Record Documents (as-built documents) on a daily basis and review with Commissioning Authority.
- i) Gather operation and maintenance data for equipment and systems, assemble the data as specified in Section 01781 "Operation and Maintenance Data," and submit them to the Commissioning Authority.
- j) Demonstrate the operation of each piece of equipment to the Owner's operation and maintenance personnel and Commissioning Authority. Schedule subcontractors and equipment manufacturer's authorized service representatives as may apply to demonstrate the operation of the equipment and systems.
- k) Assist the Commissioning Authority in performance verification testing.

#### 1.7.7 Responsibilities of Other Subcontractors and Equipment Suppliers:

- a) Attend initial commissioning coordination meeting and other meetings schedule by the Commissioning Authority.
- b) Assign representatives with expertise and authority to act on behalf of the subcontractor and equipment supplier and schedule them to participate in Commissioning Team activities when requested to do so by the Commissioning Authority, including but not limited to the following:
  - (1) Participate in training Owner's operations and maintenance personnel as scheduled and coordinated by the Commissioning Authority.

### 1.8 COMMISSIONING DOCUMENTATION

1.8.1 Basis of Design Documentation: The mechanical design professional in collaboration with the architectural and electrical design professionals of the D/B Contractor shall prepare the Basis of Design Documentation, which is the formal listing of all information and criteria selected to accomplish the design intent. At a minimum, the Basis of Design shall include, but is not limited to, the following

- a) Indoor dry-bulb temperature for all occupancy conditions.
- b) Indoor relative humidity for all occupancy conditions.
- c) Outdoor dry-bulb temperature for each season.
- d) Outdoor wet-bulb temperature for each season.
- e) Occupancy, hours, functional use, and degree of activity for all 8,760 hours per year for each activity and/or physical area.



- f) Lighting power and controls for defined levels of illumination.
- g) Miscellaneous power for all occupancy and operating conditions.
- h) Ventilation criteria and effectiveness for all occupancy and operating conditions.
- i) Special internal loads and other owner requirements.
- j) R-values for exterior envelope, including exterior walls, roof, windows, doors, and other openings in the exterior envelope.
- k) Percentage of fenestration or actual area.
- l) Building pressurization and infiltration for all occupancy and operating conditions.
- m) Maintenance management program.
- n) Building size, mass, orientation, and characteristics.
- o) Description of the HVAC systems.
- p) HVAC system's operating pressures and flow rates for normal occupancy and emergency conditions.
- q) HVAC system control strategies for normal occupancy and emergency conditions, including temperature setpoints.
- r) Codes, standards, and guideline requirements.
- s) Air quality criteria.
- t) HVAC noise and vibration criteria.
- u) Fire and smoke control and life safety criteria.
- v) Energy demand and performance criteria.
- w) HVAC equipment and system maintainability criteria.
- x) HVAC system and equipment quality standards.
- y) Air cleaning, both particulate and gaseous.

#### 1.8.2 Commissioning Plan:

- 1.8.2.1 Preliminary Commissioning Plan, updated during the design phase, shall include, but is not limited to the following:

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- a) Plan for delivery of submittals, operations manual and maintenance manual materials, and other documents and the relationship to other functions or payments.
- b) Detailed description of the organization, layout, and content of documentation.
- c) Identification of equipment and systems to be commissioned.
- d) Detailed description of commissioning schedules.
- e) Detailed identification of what must be completed before the next operation can proceed.
- f) Detailed description of the responsibilities of each party.
- g) Detailed description of the methods to be used by each party.
- h) Detailed description of the observations to be made.
- i) Detailed description of the submittals that are required to support the commissioning process.
- j) Detailed description of the documents to be provided along with the identification of the responsible party.
- k) Detailed description of the verification procedures along with identification of the parties involved and the responsible party.
- l) Detailed description of the test procedures along with the identification of the parties involved and the responsible party.
- m) Detailed description of the requirements for training of the operations and maintenance personnel, including required manuals.
- n) Detailed description of the requirements for the Systems Manual.
- o) Specification of acceptable performance for all equipment, systems, and controls.
- p) Sample report formats.
- q) Sample document / manual formats.

1.8.2.2 Design-Phase Commissioning Plan: Update the Commissioning Plan to include the following:

- a) Identify f equipment and systems to be commissioned.
- b) Describe commissioning schedules.

- c) Identify what must be completed before the next operation can proceed.
- d) Describe responsibilities of each party.
- e) Describe methods to be used by each party.
- f) Describe observations to be made.
- g) Describe submittals that are required to support the commissioning process.
- h) Describe documents to be provided along with the identification of the responsible party.
- i) Describe verification procedures along with the identification of the parties involved and the responsible party.
- j) Describe test procedures along with identifying parties involved and the responsible party.

1.8.2.3 Construction-Phase Commissioning Plan: Update the Commissioning Plan to reflect installed equipment and system(s) and incorporate design changes that occurred during the construction phase. Coordinate commissioning activities with the overall construction schedule, and identify parties to perform the commissioning activities. At a minimum, the Construction-Phase Commissioning Plan, detailed in the construction phase, shall include:

- a) Method for documenting changes to appear in as-built records on a continuous basis.
- b) List of all equipment and systems involved in the commissioning process.
- c) Pre-start/start-up checklists for all equipment and systems involved in the commissioning process.
- d) A detailed step-by-step procedure for conducting the tests on each piece of equipment and system, with provisions for verifying relevant data, recording the results obtained, and listing parties involved in each test.
- e) Detailed schedule for commissioning activities, with specific dates consistent with overall construction schedule.

1.8.3 Test and Inspection Plans and Reports: Compile test and inspection plans, test and inspection reports, and test and inspection certificates and include them in the Systems Manual and Commissioning Plan.

1.8.4 Certificate of Readiness: Commissioning Authority shall certify that equipment and systems, including controls, that are involved in the commissioning process have been correctly installed, started as specified, and tested, adjusted, and balanced. Completed pre-start

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and start-up checklists signed by the responsible parties shall support this certificate.

1.8.5 Test Checklists: Signed checklists covering each completed test, containing. The checklist shall be specific for each individual piece of equipment, subsystem, or system, and shall include the following:

- a) Name and identification code of tested item.
- b) Time and date of the test.
- c) Individuals present for test.
- d) Calibration of sensors and sensor function.
- e) Control sequence.
- f) Strength of control signal for each setpoint at specified conditions.
- g) Responses to control signals at specified conditions.
- h) Sequence of response(s) to control signals at specified conditions.
- i) Electrical demand or power input at specified conditions.
- j) Power quality and related measurements.
- k) Actual flow rates at specified conditions.
- l) Inlet and outlet temperatures of all fluid streams at specified conditions.
- m) Inlet and outlet pressures, or pressure drops, of all fluid streams at specified conditions..
- n) Responses to defined temporary upset of system operation.
- o) Interaction of auxiliary equipment such as water treatment.
- p) Trend logs.
- q) Deficiencies.

1.8.6 Corrective Action Documentation: Document corrective action taken for equipment and systems that fail test. Include required modifications to equipment and systems and revisions to test procedures. Retest equipment and systems requiring corrective action and document retest results. Report and document variance from the defined criteria that is acceptable and requires no modification.

1.8.7 Commissioning Report: Document the results of the commissioning process, including the as-built performance of the system and unresolved issues. The Commissioning Report shall indicate the HVAC

system has been completed according to the Contract Documents and the systems are performing according to the final Design Intent. The Commissioning Report shall include the following:

- a) Listing and explanation of substitutions, compromises, or variances in final Design Intent, Contract Documents, and As-Built conditions, and the report may make recommendations for resolution. This report shall be used to evaluate the system and serve as a future reference document during operation of the HVAC system. It shall describe components and performance that exceed Design Intent and those that do not meet Design Intent. It may also include a recommendation for acceptance or rejection of the systems.
- b) Design Intent document.
- c) Commissioning Plan.
- d) Verified testing, adjusting, and balancing report.
- e) Listing of deficiencies outside the scope of the HVAC system that impact HVAC system performance.
- f) Corrective modification documentation.
- g) Accepted performance variance documentation.
- h) Pre-start/start-up checklists.
- i) Completed test checklists.
- j) Listing of off-season test(s) not performed and a schedule for their completion.

1.8.8 Updating Documentation: Update system operation descriptions and equipment data, including performance data, for training of and subsequent use by the operations and maintenance staff. Updated documentation shall be included in Systems Manual.

1.8.9 Issue Log: Create and maintain an Issues Log that includes detailed descriptions of design, installation, or performance issues that are at variance with Contract Documents or the Design Intent document. Issues shall be identified and tracked as they are encountered. Maintain the Issues Log with status of unresolved and resolved issues. The following minimum information shall be documented in the Issues Log:

- a) Document the following information at the time the issue is identified:



A unique numeric or alphanumeric identifier by which the issue may be tracked.

- (2) Short, descriptive title of the issue.
- (3) Date and time of the identification of the issue.

- (4) Test number of the test being performed at the time of the observation, if applicable, for cross-reference.
  - (5) System, equipment, or assembly identification to which the issue applies.
  - (6) Location of the issue.
  - (7) Description of the observed design, installation, or performance issue. Include any information that may be helpful in diagnosing or evaluating the issue.
  - (8) Recommended corrective action.
  - (9) Identification of the Commissioning Team member responsible for corrective action.
  - (10) Expected date of correction.
  - (11) Person documenting the issue.
- b) Document the following information when the issue is resolved:
- (1) Date correction completed or issue resolved.
  - (2) Description of corrective action taken or resolution. Include description of diagnostic steps taken to determine the root cause of the issue, if any.
  - (3) Identification of changes to the Design Intent or Basis of Design that require action.
  - (4) Statement that the correction was completed and the system or assembly is ready for retest, if applicable.
  - (5) Person who corrected or resolved the issue.
  - (6) Person documenting the issue resolution.
- c) Issue Report: On a periodic basis, at least for each Commissioning Team meeting, Commissioning Authority shall create a written narrative for review of outstanding issues and a status update of the Issues Log. As a minimum, include the following information in the Issues Log and expanded in the narrative:
- (1) Issue number.
  - (2) Short, descriptive title of the issue.
  - (3) Date of the identification of the issue.
  - (4) Name of the Commissioning Team member assigned responsibility for resolution.
  - (5) Expected date of correction.

1.8.10 Systems Manual: Commissioning Authority shall compile the systems manual which shall include the following:

- a) Index of commissioning documents notated storage location of each document.
- b) Commissioning Report.
- c) Final design intent documents.
- d) Record (As-built) documents.
- e) Description of systems, including capabilities and limitations.
- f) Operating procedures for normal and emergency modes of operation.
- g) Sequence of operations as actually implemented, with control system data including all setpoints and calibration data.
- h) Locations of control sensors and test ports.
- i) Seasonal start-up and shutdown procedures.
- j) Control schematics and computer graphics.
- k) Complete terminal interface procedures and capabilities for DDC systems.
- l) A list of recommended operational record-keeping procedures including sample forms, trend logs, or others, and a rationale for each.
- m) Maintenance procedures.

1.9 SUBMITTALS

- 1.9.1 Commissioning Plan: Commissioning Authority shall submit the Commissioning Plan to the D/B Contractor and Owner.
- 1.9.2 Basis of Design Documentation: The Design/Build Contractor shall submit the Basis of Design Documentation to the Owner and Commissioning Authority.
- 1.9.3 Sample Test Forms: Commissioning Authority shall develop and submit sample test report forms that indicate format and content for data required by test procedures to the D/B Contractor and Owner.

1.10 QUALITY ASSURANCE

- 1.10.1 Test Equipment Calibration Requirements: Comply with test equipment manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damage. Affix calibration tags to test instruments.

## 1.11 COORDINATION

- 1.11.1 Preconstruction Meeting: A meeting of the Commissioning Team, chaired of the Commissioning Authority, to review the scope of commissioning process activities and the Commissioning Plan with discussions of the milestones, activities, and assignments of responsibility.
- 1.11.2 Coordinating Meetings: **[Weekly] [Bi-weekly] [Monthly] <Insert frequency>** coordination meetings of the Commissioning Team, chaired by the Commissioning Authority, to review progress on the Commissioning Plan, scheduling conflicts, and to discuss strategies and processes for upcoming commissioning process activities.
- 1.11.3 Pretesting Meetings: Pretest meetings by the Commissioning Team, chaired by the Commissioning Authority, to review startup reports, pre-test inspection results, testing procedures, testing personnel and instrumentation requirements, and manufacturers' authorized service representative services for each system, subsystem, equipment, and component to be tested.
- 1.11.4 Testing: Commissioning Authority shall coordinate with testing personnel and agencies for schedule and access to witness testing.
- 1.11.5 Manufacturers' Inspection and Startup Services: Commissioning Authority shall coordinate services of manufacturers' inspection and startup services.
- 1.11.6 Testing, Adjusting, and Balancing: Commissioning Authority shall coordinate schedule for testing, adjusting, and balancing for schedule and access to witness processes.

## PART 2 - PRODUCTS (Not used)

## PART 3 - EXECUTION

### 3.1 CONSTRUCTION CHECKLISTS

- 3.1.1 Final construction checklists for each component, equipment, system, and assembly, as detailed in Section 01815, "HVAC Commissioning Processes" will be provided by the Commissioning Authority **<Insert number>** days after approved shop drawings.
- 3.1.2 Complete the construction checklists for each component, equipment, system, and assembly as the work is accomplished.

### 3.2 GENERAL REQUIREMENTS FOR TESTING PREPARATION

- 3.2.1 Prerequisites for testing include the following:
  - a) Pre-test inspection of systems, subsystems, equipment, and components verify readiness for testing and Certificates of Readiness signed and submitted.
  - b) Systems, subsystems, equipment, and components startup inspections, checks, and startup procedures have been approved. [CBD: who approves? This will have to be a



provision added to the General and Supplementary Requirements, not here.]

c) "Defective Work" as defined in the General Conditions of the Contract for Construction has been corrected.

d) Pretest set points are recorded.

### 3.3 GENERAL DOCUMENTATION REQUIREMENTS

3.3.1 Pre-Test Inspection Checklists: In cooperation with manufacturers and installers, develop checklists for use in inspecting systems, subsystems, equipment, and components before startup and testing are performed. Include identification of system, subsystem, or equipment, identification of manufacturer and installer.

3.3.2 Certificate of Readiness: Signed by the Contractor and Installer(s), certifying that systems, subsystems, equipment, and associated controls are ready for testing. Prepare certificates on approved forms.

3.3.3 Prepare Test Data Reports: Record test data, observations, and measurements. Data shall be recorded on photographs, forms, and other means appropriate for the application. Record the following minimum information: [Contractor create forms and submits forms for approval. The contract fills in forms, CxA observes them doing so, and then approves results.]

a) Test number.

b) Date and time of the test.

c) Indication of whether the record is for a first test or retest following correction of a problem or issue.

d) Identification of the system, subsystem, assembly, or equipment.

e) Conditions under which the test was conducted, including (as applicable) ambient conditions, set points, override conditions, and status and operating conditions that impact the results of the test.

f) Expected performance of the systems and assemblies at each step of the test.

g) Narrative description of observed performance of the system, equipment, or assembly.

h) Notation to indicate whether the observed performance at each step meets the expected results.

i) Issue number, if any, generated as the result of the test.

j) Dated signatures of the person performing the test and of the witness, if applicable.

### 3.4 GENERAL TESTING REQUIREMENTS

- 3.4.1 Test systems and inter-system performance after Construction Checklists for equipment and components of system to be tested have been approved.
- 3.4.2 Perform test specified in other Division 1 commissioning process activity Sections and other sections specifying testing procedures according to approved testing procedures.
- a) Verify and test performance using actual conditions whenever possible.
  - b) Simulate conditions by imposing an artificial load when it is not practical to test under actual conditions and when written approval for simulated conditions is received from Commissioning Authority. Before simulating conditions, calibrate testing instruments. Set and document simulated conditions and methods of simulation. After test, return settings to normal operating conditions.
  - c) Alter set points when simulating conditions is not practical and when written approval for is received from Commissioning Authority
  - d) Overwrite sensor values with a signal generator when actual or simulate conditions and altering set points are not practical. Do not use sensor to act as the signal generator to simulate conditions or overwrite values.

### 3.5 <INSERT ARTICLE TITLE>

END OF SECTION 01810